Patent Claims

1. An apparatus for producing water on board of an aircraft while using one or more fuel cells, wherein a partial or complete integration of a water production unit in the form of one or more high temperature fuel cells (7) into an aircraft engine is provided in such a manner that the combustion chambers (7A) of the aircraft engine are replaced completely or partially by the high temperature fuel cells (7) and thus either supplementing or completely replacing the process that takes place in the conventional type combustion chambers, characterized in that the high temperature fuel cells (7) are constructed as type: oxide ceramic fuel cell (SOFC - solid oxide fuel cell) or as a molten carbonate fuel cell (MCFC), or a type that is comparable in power and temperature level; that pure hydrogen is supplied to the anode side of said high temperature fuel cells (7), that air is supplied to the cathode side of said high temperature fuel cells, that a mixture of hydrogen and air is supplied to the combustion chambers (7A), that at least the hydrogen supply is constructed for a closed loop control or can be shut off completely, and that a single stage or multistage turbine (16) is connected downstream of the anode side of the high temperature fuel cell, said turbine converting the thermal energy of the anode exhaust gas (35) into rotation energy.

2. The apparatus of claim 1, characterized in that the conversion of the thermal energy takes place by a Stirling motor and/or by one or more combinations of different thermal engines, for example a turbine and a Stirling motor.

3. The apparatus of claim 1 or 2, characterized in that the gained mechanical energy is supplied to a compressor (13).

4. The apparatus of one of claims 1 to 3, characterized in that the compressor is used for charging the anode side with hydrogen (15) under pressure.

5. The apparatus of one of claims 1 to 4, characterized in that a condensation process (18) is connected downstream of the high temperature fuel cell or high temperature fuel cells (7), said condensation process condensing water out of a portion of the anode exhaust gas (35) of the fuel cell (7).

6. The apparatus of one of claims 1 to 5, characterized in that the high temperature fuel cells (7) are constructed for pressurizing both sides, on the air or oxygen side, on the one hand, and on the fuel or hydrogen side, on the other hand, whereby equal or even different pressures are permissible on the anode side and on the cathode side.

7. The apparatus of one of the claims 1 to 6, characterized in that liquid or gaseous hydrogen is used.

8. The apparatus of one of claims 1 to 7, characterized in that liquid hydrogen (1) is evaporated (at 17) prior to entry into the high temperature fuel cells (7) or into the combustion chambers (7A).

9. The apparatus of one of claims 1 to 8, characterized in that the evaporator (17) is constructed to be operable by process heat of the anode exhaust gas condenser (18).

10. The apparatus of one of claims 1 to 9, characterized in that the evaporator (17) is constructed as a pipe bundle heat exchanger which is arranged as a ring shape around the condenser (18) or circularly within the condenser (18).

11. The apparatus of one of claims 1 to 10, characterized in that at least a portion of the condensation process (18) is operated with cooling air (19).

12. The apparatus of one of claims 1 to 11, characterized in that used water and not needed condensate are collected in a container (32) (gray water).

13. The apparatus of one of claims 1 to 12, characterized in that the air (20) heated in the condensation process (18) is used for evaporating the gray water in a separate

container (33), wherein a pump (37) feeds the gray water into said container, and in that a filter is provided for retaining solid and suspended matter.

14. The apparatus of one of claims 1 to 13, characterized in that the produced steam is blown in upstream of the second turbine stage (low pressure stage 9) where it is mixed with cathode exhaust air (36).

15. The apparatus of one of claims 1 to 14, characterized in that any germs and microorganisms possible present from the gray water (32) are thermally killed.

16. The apparatus of one of claims 1 to 15, characterized in that water of distilled quality is withdrawn from the condensation process (18) and distributed, that drinking water generated by adding a dose of salt is supplied to galleys (23), hand wash basins (24) and showers (25), and that the toilets (water closets 27) and the air humidifying (26) are supplied with distilled water.

17. The apparatus of one of claims 1 to 16, characterized in that the turbine stages (8, 9) drive the compressor stages (5, 6) and the fan (11), and that the compressor stages (5, 6) pressurize the air side of the high temperature fuel cells (7) and of the combustion chambers (7A).

18. The apparatus of one of claims 1 to 17, characterized in that the air throughput (3) of the fan (11) is used either in an engine for propulsion or in an APU for pressurization of the pressurized air systems and/or of the air conditioning.

19. The apparatus of one of claims 1 to 18, characterized in that respectively the fan (11) is coupled with the first compressor stage (2) and with the second turbine stage (9), and the second compressor stage (6) and the first turbine stage (8) are coupled with each other and run on coaxial shafts (one within the other) with different revolutions per minutes.

20. The apparatus of one of claims 1 to 19, characterized in that the number of the coupled compressor stages and turbine stages, the direction of rotation of these stages, and the number of coaxial shafts rotating one within the other are constructed at discretion.

21. The apparatus of one of the claims 1 to 20, characterized in that the waste water is collected in a collecting tank (28), completely or partially dehydrated at (30) and the thus gained water portion is fed into the gray water collection tank (32).

22. The apparatus of one of claims 1 to 21, characterized in that the apparatus is constructed for also being operable without supplying water to a water system.

23. The apparatus of one of claims 1 to 22, characterized in that the combustion chambers and the high temperature fuel cells can be operated separately and in any desired combination.

24. The apparatus of one of claims 1 to 23, characterized in that individual combustion chambers or high temperature fuel cells are adapted to be switched off for a separate operation of combustion chambers or high temperature fuel cells.